5.1.2 Solid, liquid and gas

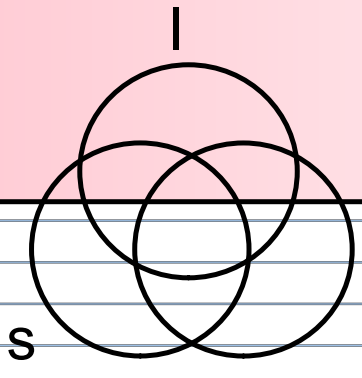
	Learning outcomes	Additional guidance
	Learners should be able to demonstrate and apply their knowledge and understanding of:	
(a)	solids, liquids and gases in terms of the spacing, ordering and motion of atoms or molecules	HSW1
(b)	simple kinetic model for solids, liquids and gases	HSW1
(c)	Brownian motion in terms of the kinetic model of matter and a simple demonstration using smoke particles suspended in air	HSW2

(6) M - Describe solids liquids and gases in terms of spacing , ordering and motion of atoms or molecules
(7) S - Describe a simple kinetic model for solids, liquids and gases
(8) C - Describe an experiment that demonstrates Brownian motion

Lesson 2 Phases of matter

STARTER: In groups complete the Venn diagram to detail what you know about the **particles** of the 3 main states of matter in terms of spacing, ordering and motion.

Now magpie a different idea each from another group.



Ex Explain what is meant by **kinetic theory / the kinetic model**?

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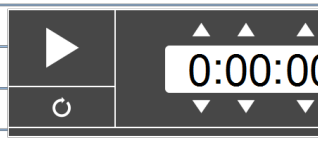

The kinetic model describes that substances are made from particles / are arranges differently depending on the phase / can change phase based on the KE of the particles.

	Solid	**Liquid**	**Gas**
Spacing / attraction	Tightly/closely packed Strong electrostatic forces	Tightly/closely packed some electrostatic forces	Large distances between particles Negligible forces of attraction
Ordering / arrangment	Regular structure / pattern Good long range order	random ordering / no pattern Poor long range order / disordered Change position and flow	Disordered / random arrangement Poor long range order Change position and flow
Motion/speed	Vibrate about fixed position.	Some vibration and translational motion. Greater KE	Highest KE Translational motion only (no vibration)

Extension: Use kinetic theory to explain the basic properties of SLG, like **density** etc.

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Print activity

	Solid	**Liquid**	**Gas**
Spacing / attraction			
Ordering / arrangment			
Motion/speed			

Tightly/closely packed

some electrostatic forces

Highest KE

Translational motion only (no vibration)

Regular structure / pattern

Good long range order

Tightly/closely packed

Strong electrostatic forces

Vibrate about fixed position.

random ordering / no pattern

Poor long range order / disordered

Change position and flow

Large distances between particles

Negligible forces of attraction

Some vibration and translational motion.

Greater KE

Disordered / random arrangement

Poor long range order

Change position and flow

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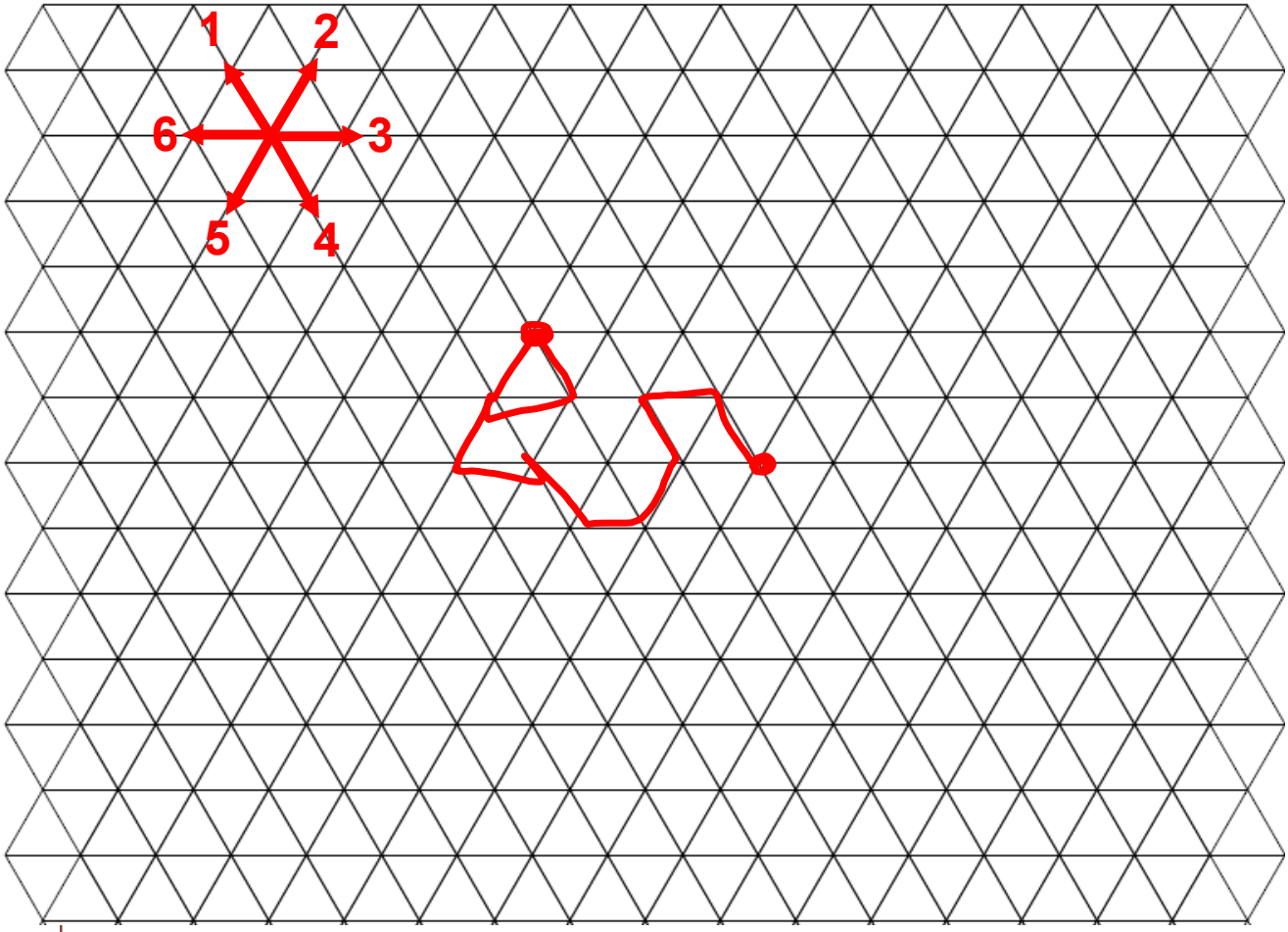
The motion of 1 molecule of gas.



Start in the centre. Take 25 random steps using the dice.

1. What is a change of direction representing?
2. What does the overall displacement represent?
3. **Explain** if this is a good or bad model of gas particle motion.

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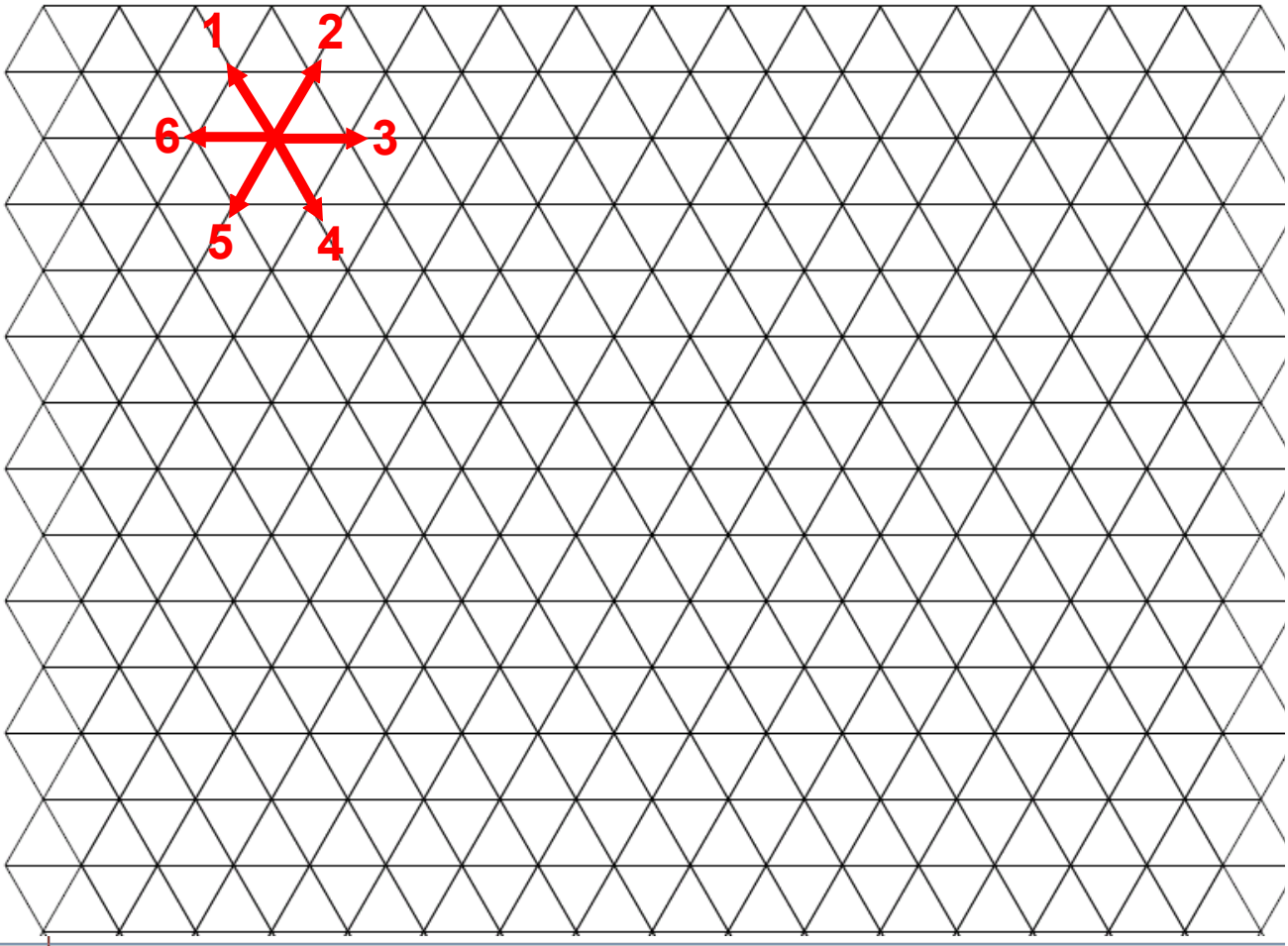

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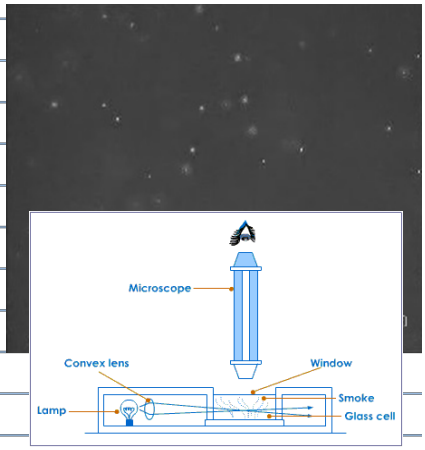
Brownian motion

brownian motion
(60 symbols)

The idea that matter was made from particles was confirmed by Robert brown in 1827, and explained fully by Einstein.



1. Describe an experiment used to observe Brownian motion
2. Explain why smoke is used?
3. State and explain the evidence for Brownian motion provided by this experiment?
4. Why do the smoke particles take the paths observed?
5. What do the observations imply about the speed of the air particles? - think about conservation of momentum.

Answer - Self assess

1. Describe an experiment used to observe Brownian motion
2. Explain why smoke is used? (air particles smaller than the wavelength of visible light so cannot be viewed under a light microscope. But small enough to be affected by the momentum gained from the air.)
3. What is the evidence for Brownian motion provided by this experiment? Smoke moves in a random . haphazard motion / random path, therofore must be affected by a random force from other particles)
4. Why do the smoke particles take the paths observed? (collisions with air particles)
5. What do the observations imply about the speed of the air particles? (smoke moves slowly, but is massive, air particles less massive so must be faster)